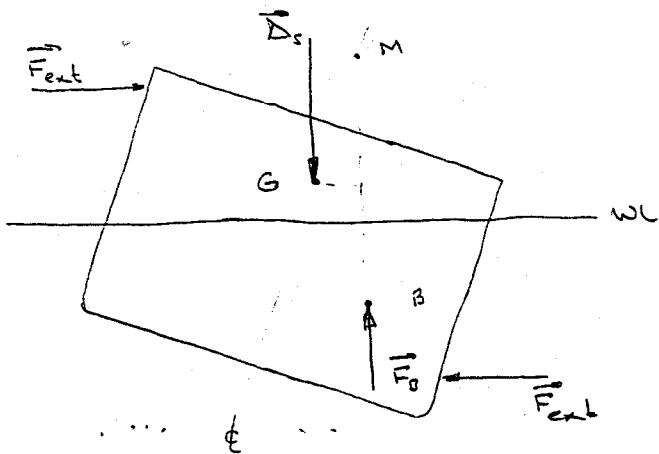


1. Describe why a ship displaying positive stability will return to static equilibrium after being subjected to an external upsetting moment.



As the ship heels in response to the external moment, an internal couple is generated opposing the external moment. The internal couple is composed of the ship's displacement and buoyant force. As the ship heels, the location of the center of buoyancy moves, causing the location of the resultant buoyant force to shift. It is this shift of the center of buoyancy and resultant buoyant force that creates the internal couple that causes the ship to return to static equilibrium.

2. Ship has submerged volume of  $\nabla = 112,000 \text{ ft}^3$ , and righting arm of 2 ft when heeling to 15 degrees.

Find: righting moment of the ship at 15°

$$RM = \overline{GZ} \Delta$$

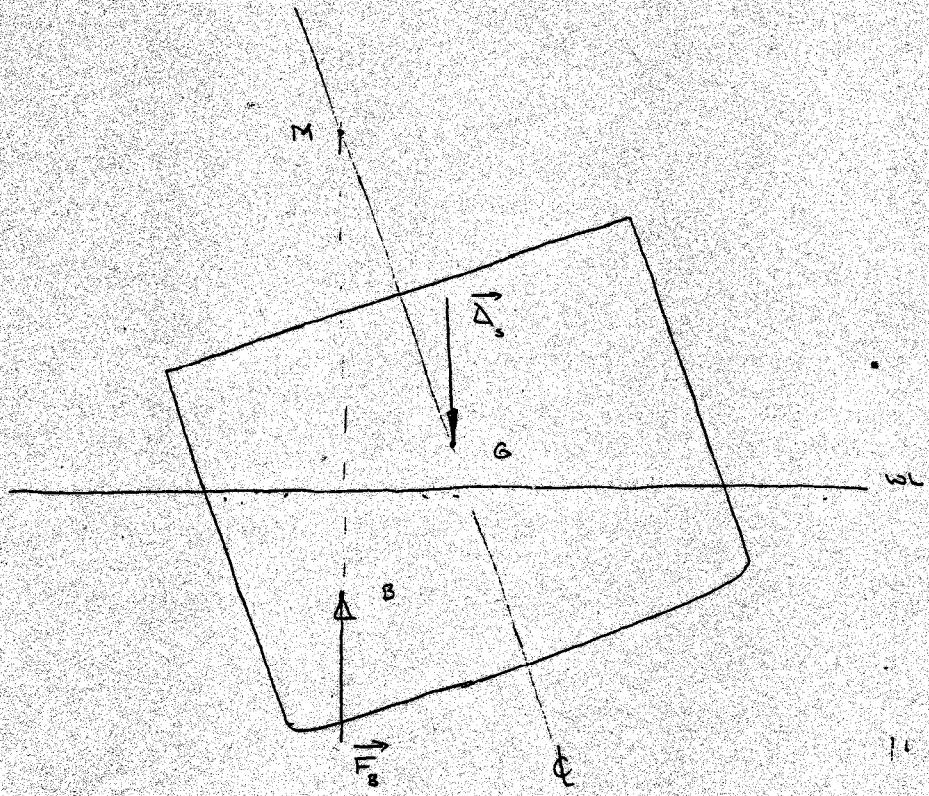
$$\Delta = \rho g \nabla = (1.09 \frac{\text{lb}}{\text{ft}^3})(32.17 \frac{\text{ft}}{\text{s}^2})(112,000 \text{ ft}^3)(\frac{\text{LT}}{2240 \text{ lb}})$$

$$\Delta = 3201 \text{ LT}$$

$$RM = (2 \text{ ft})(3201 \text{ LT})$$

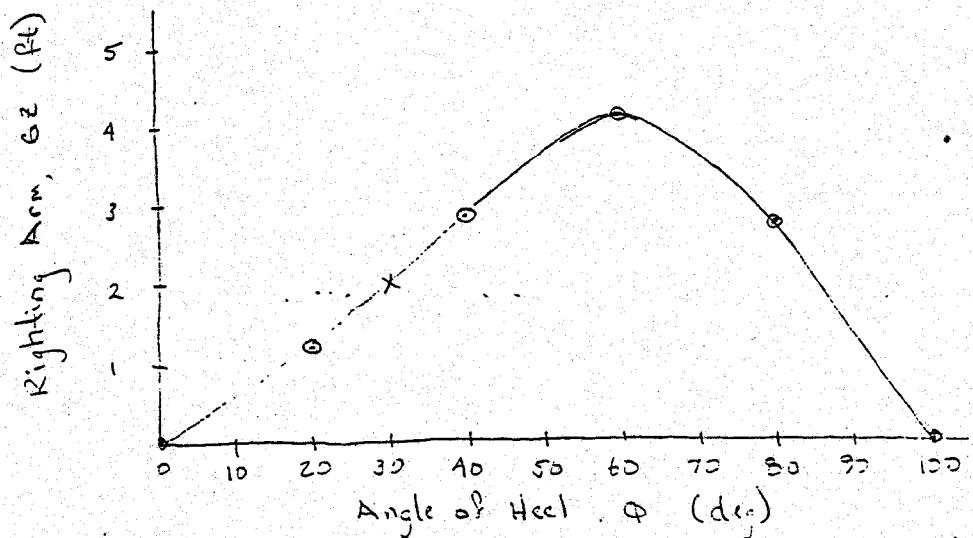
$$\therefore RM = 6402 \text{ LT} \cdot \text{ft}$$

Sketch a diagram of a positively stable ship heeling to port.

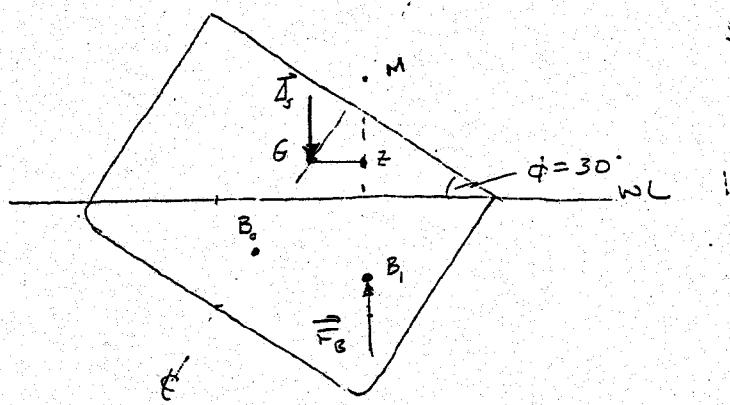


Ship has  $\Delta = 3600 \text{ t}$  and  $X_G = 18.0 \text{ ft}$ . Using following data, plot curve of Intact statical stability for starboard heels only.

Angle of Heel, $\phi$ (deg)	0	20	40	60	80	100
Righting Arm, $GZ$ (ft)	0.0	1.2	2.8	4.1	2.7	0.0



Sketch diagram of ship heeled 30° to starbord. Calculate righting moment developed at this angle.



From curve of Intact stability  $\in \phi = 30^\circ$

$$GZ_{30} = 2 \text{ ft}$$

$$\begin{aligned} RM_{30} &= GZ_{30} \Delta_s \\ &= (2 \text{ ft}) (3600 \text{ t}) \end{aligned}$$

$$\therefore RM_{30} = 7200 \text{ t.ft}$$

If KG were raised to 18.5 ft,  $\Delta_s$  would decrease causing a reduction